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ECONOMIC PROCEEDINGS

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XIX.

INJURIOUS INSECTS AND OTHER ANIMALS OBSERVED IN IRELAND DURING THE YEAR 1906. BY GEORGE H. CARPENTER, B.SC., M.R.I.A., F.E.S., Professor of Zoology in the Royal College of Science for Ireland, and Consulting Entomologist to the Royal Dublin Society.

(PLATES XXXIX.-XLIV.)

[Read, JUNE 18; Received for Publication, JUNE 21; Published, AUGUST 22, 1907.]

PARASITES OF DOMESTIC ANIMALS.

The Sheep-Louse.

Trichodectes sphærocephalus, Nitzsch.

IN January, 1906, wool infested with specimens of this parasite was received from sheep on Mr. John Borland's farm, at Angleboro' Mountain, near Mitchelstown. The flock had become contaminated by the straying in of undipped sheep from the neighbourhood; and though the lice appeared to be killed off by dipping, with an arsenic and whale-oil wash, in summer, autumn, and spring, they re-appeared in numbers the succeeding season, without any known contact with fresh sources of infestation.

These insects are not true sucking lice (Anoplura), but "biting lice" of the group Mallophaga, provided with stout toothed mandibles (fig. 1, B, *m*); by means of these jaws the insects bite their host's hairs and the surface and secretions of the skin, which serve as their food. Occasionally they draw blood from the host-animal. The legs are strong and stout (fig. 1, A, *D*), furnished in the family Philopteridæ, to which the present species belongs, with a single powerful claw, arranged so as to close against a blunt spine (fig. 1, *D*, *a*, *b*) on the foot, and thus to embrace a hair of the host, enabling the parasite to cling firmly. In the Philopteridæ, the mouth is situated beneath the head, and

the second pair of maxillæ, united to form the "lower lip" or labium (fig. 1, B, *l*), are much reduced. The genus *Trichodectes* is easily recognized by the presence of only three segments in the feeler (fig. 1, A, B). In the present species the terminal segment of the feeler in the male is stouter and stronger than in the female, and bears several conspicuous sensory spines (fig. 1, B). The abdomen of the male (fig. 1, C) can be distinguished from that of the female (fig. 1, A) by the presence of a pair of conspicuous claspers, visible through the hinder segments. *T. sphaerocephalus* is 1.5 mm. (about $\frac{1}{16}$ inch) in length.

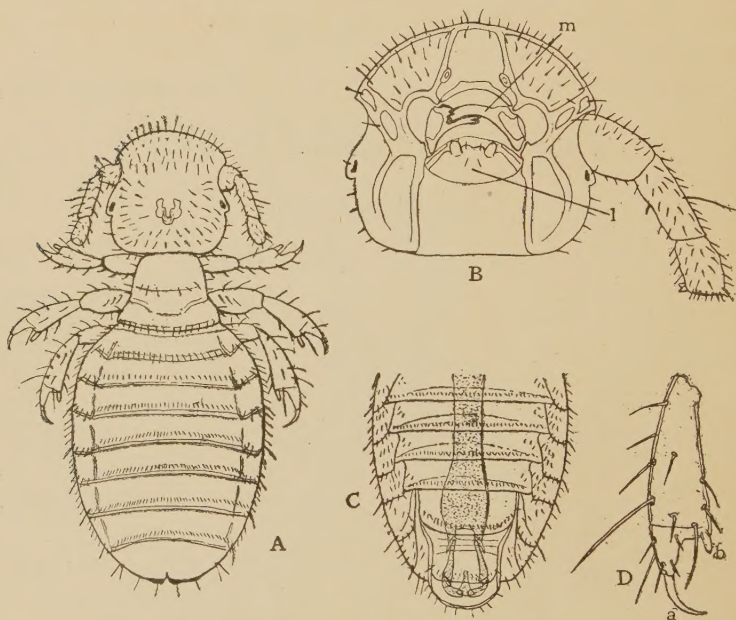


FIG. 1.—Biting Louse of the sheep (*Trichodectes sphaerocephalus*, Nitzsch).

A. Female, dorsal view. Magnified 40 times.

B. Head of male, ventral view. Magnified 80 times. *m*, mandible; *l*, labium.

C. Abdomen of male, ventral view, showing claspers. Magnified 40 times.

D. Shin and foot of hind-leg. Magnified 80 times. (*a*) claw; (*b*) blunt spine against which claw works.

It is well known that the eggs of these parasites are attached to the hairs of the host, on whose body the whole life-history is normally carried on. It seemed likely, therefore, that the re-

appearance of the insects some months after dipping was due to the resistance of the eggs to the effect of the dip. I recommended that on the next occasion a second dipping should be given about ten days after the first, as by that interval, the young lice would have probably been hatched from the eggs, and would thus be subjected to the poisonous action of the dip. From information kindly furnished by Mr. Borland in May, 1906, and again in January of the present year, I am able to record that this treatment proved altogether successful. Not a single louse had been observed on the sheep during the past twelve months. I am much indebted to Mr. Borland for permission to make these particulars known, in the hope that the facts may be of service to other flock-masters.

CORN INSECTS.

The Long-horned Barley-fly.

Elachyptera cornuta (Fallen).

In a previous paper of this series (4 (1905), pp. 282-5), reference was made to the presence of maggots of the well-known "Gout-fly" in barley. In August of the past year my attention was called to the experimental barley plots at the Albert Agricultural College, Glasnevin, under the care of Mr. H. Hunter, of the Department of Agriculture and Technical Instruction. A number of the plants showed swellings at the base, the enlargement being far less than that due to the presence of the Gout-fly maggot, and the plants being apparently able to "grow away" from the attack. Removal of the sheathing leaves revealed small brown puparia (fig. 2, *c*) close to the haulm, and a portion of the tissue where maggots had evidently been feeding was yellow and withered. Unfortunately no maggots could be found in the act of feeding; all had apparently entered the pupal stage. From the puparium it is evident that the tail-spiracles are situated on prominent paired processes. The puparia were, however, preserved, and late in September a number of flies emerged from them. These have been kindly identified for me by Mr. P. H. Grimshaw, of the Royal Scottish Museum, Edinburgh, as *Elachyptera cornuta* (Fallen).

This fly is included in the same sub-family (Chloropinæ) with the genera to which the Gout-fly (*Chlorops tæniopus* Meig.) and the Frit-fly (*Oscinis frit*, Linn.) respectively belong. *Elachyptera* may be distinguished from other genera of this group, by the relative shortness of the wings, by the extension of the costal nervure around the tip of the wing to meet the fourth longitudinal nervure, and by the thick, prominent "bristle" on the third segment of the feeler (fig. 2, b).

The present species, *E. cornuta* (fig. 2, a), is one of two species of the genus inhabiting our islands; the other, *E. brevipennis* (Meigen), has excessively short wings. Both were known as

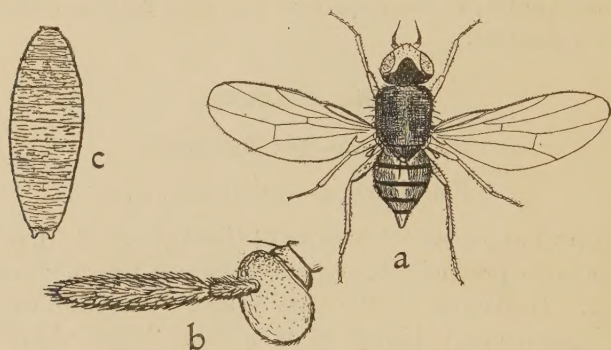


FIG. 2.—(a) *Elachyptera cornuta* (Fallen). Magnified 8 times. (b) feeler (side view showing coarse, hairy "bristle." Magnified 60 times. (c) Puparium. Magnified 8 times.

Irish insects to Haliday. *E. cornuta* is a small fly about 3 mm. ($\frac{1}{8}$ inch) in length, shining black in colour, with two rather broad, greyish stripes on the fore-body, and a shining brownish-black abdomen. The head is reddish yellow, with a rather large, black, triangular marking on the crown. The feelers are reddish-yellow, with their conspicuous "bristles" brownish-black. The legs are entirely yellow, except for the darker feet, and occasional median dark markings on the thighs and shins. (See Schiner, 14, ii., pp. 231-3).

It is probable that the autumn brood of flies which I succeeded in rearing would lay their eggs on wild grasses, as is the habit of the allied Gout-flies, and that the maggots from these eggs, after wintering, would become a spring-brood of flies to lay eggs on

the young corn. The burning of refuse from an attacked crop with the contained puparia, which have been shown to rest within the sheathing leaves, would be, in any case, an obvious preventive measure.

CABBAGE AND TURNIP INSECTS.

The Diamond-back Moth.

Plutella cruciferarum, Zell.

The year 1901 was noteworthy for the prevalence of this insect in cabbage and turnip fields in our eastern Irish counties (4, pp. 144-7, figs. 16-21); but in that year no complaints of damage by the caterpillars were received from the west. It was of especial interest, therefore, to learn from Mr. J. Kelly, of the Department's Agricultural Station at Athenry, Co. Galway, that Swede turnips in that locality were suffering in July from the ravages of the caterpillars. Mr. Kelly kindly forwarded leaves for examination. In the same month I also received leaves eaten by these caterpillars from Mr. T. A. Rudd, Agricultural Instructor for West Co. Cork. It will be remembered that in 1905 (4, p. 326)¹ serious damage was done by these insects in Co. Wexford.

The Root-gall Weevil.

Ceuthorrhynchus pleurostigma, Marsh.

Turnips with the well-known characteristic sub-globular galls caused by the maggots of these weevils were received in February, 1906, from Mr. M. Horgan, Agricultural Instructor in County Westmeath. Mr. Horgan wrote that this malformation gives rise to numerous complaints, as "the affected roots never properly develop, and are subsequently liable to speedy decay, especially roots stored in large heaps."

Ceuthorrhynchus is a large and important genus of small weevils, of short, broad form, with slender, elongate snout, the

¹ In the short paragraph relating to this insect (p. 326, *supra*), for "August, 1901," read "August, 1905."

funiculus of the feeler with seven segments, and the shoulders of the elytra incised. *C. pleurostigma* (more generally known as *C. sulcicollis*, Gyll) has the thighs with feeble teeth (fig. 3, 8), the legs and also the whole body dull-black in colour, with scanty greyish recumbent pubescence above, and a thick coating of whitish scales beneath, the thorax strongly constricted in front, coarsely, but not very closely punctured, with a strong central groove, and a small tubercle on either side. The length of the beetle is only 2 to $2\frac{1}{2}$ mm. ($\frac{1}{10}$ inch, or less). In the male, the hind shin is armed with a hook, the hindmost abdominal segment is deeply and widely impressed, and the last segment but one has two small tubercles in front of the apex (Fowler, 8, v., p. 353).



FIG. 3.—1, Galled Cabbage root, natural size; 6, Root-gall Weevil (*Ceuthorrhynchus pleurostigma*), natural size; 7, magnified 6 times; 8, foreleg, magnified 12 times; 4, external views of galls; 5, galls cut open, showing grubs (2) within, natural size; 3, grub, side view, magnified 4 times; 9, 10, earthen chambers of pupæ, magnified. From Ormerod, in part, after J. Curtis's "Farm Insects."

These beetles lay their eggs in spring or summer in the cabbage or turnip plants, and the presence of the grubs hatched from these eggs in the plant-tissues leads to the formation of the galls. The grub (fig. 3, 3) has a soft, whitish, wrinkled body without legs, and a hard, brown head furnished with strong mandibles. The grubs feed through the autumn, becoming fully grown in the winter or the succeeding spring, when they eat their way out of the galls, and

pupate in oval earthen cases (fig. 3, 9, 10). Miss Ormerod (12 (1895), p. 17) records that they survive even if frozen stiff, "and on being thawed will at once bury themselves and begin constructing or reconstructing their cases."

No dressing can be applied with any confidence for the destruction of the grubs, on account of their protected feeding-places, though gas-lime has been recommended as effectual. The removal of galls with their contained insects when planting out young cabbages, and the destruction by burning of badly-damaged plants, are obvious preventive measures. So is a judicious rotation of crops, as these beetles feed only on cruciferous plants.

The Cabbage Stem-Borer.

Psylliodes chrysocephala (Linn.).

(Plates XXXIX., XL.)

Through my friend and former pupil, Brother Adolphus Ryan, I received in May, 1906, young cabbage plants from Limerick, with the root and stem-base bored by larvæ which clearly belonged to some Halticine beetle allied to the "Turnip Fly." In one of the plants it was clear that the insect had bored its way into the stem through a small hole (Plate XXXIX., B i) just beneath the surface of the ground. The presence of the grubs within the central tissue led to great discoloration and decay (Plate XXXIX., B ii). One of them pupated in an earthen chamber about 3 inches below the surface of some soil provided, and in three weeks' time this specimen developed into the common "flea beetle," *Psylliodes chrysocephala*. The genus *Psylliodes* is distinguished from the "Turnip flies" (*Phyllotreta*) and from most other Halticinæ by the presence of only ten (instead of eleven) segments to the feeler, and by the production of the hind shin into a process that reaches some distance beyond the insertion of the foot. Two species of *Psylliodes* are well known by their ravages in the perfect stage. These are the Hop Flea-Beetle, *P. attenuata* (Koch), and the Potato Flea-beetle, *P. affinis*, Payk. The latter of these has often attracted notice in Ireland (4 (1904), pp. 254-5; (1906), p. 329). *P. chrysocephala* (Plate XXXIX., A) is commonly taken by sweeping various cruciferous plants. It is about 4 mm. ($\frac{1}{6}$ inch) in length,

of a metallic green colour, the front of the head, the three basal segments of the feelers, the thighs of the fore and median legs, and all the shins being yellowish. On the Continent this beetle is frequently destructive to Rape, devouring the leaves and flower-buds, according to Ritzema Bos (3, p. 367) and Kaltenbach (9, p. 29).

As it appeared that no larva of this genus had ever been carefully described, I published (5) an account with figures (Plate XL.) of the principal points in its external structure. From this account the following details are here reproduced:—

The fully-grown larva of *Psylliodes chrysocephala* is 8 mm. in length and narrowly sub-cylindrical in form (Plate XL., fig. 1). Excepting for the head, the pronotal shield, and the ninth abdominal tergum, the cuticle is soft and white. The three pairs of short thoracic legs and the “anal proleg” are present, as is usual in larvæ of this section of the Chrysomelidæ.

Head.—The form of the head and the arrangement of its bristles may be gathered from figs. 2, 4, and 5.¹ Except in the gular region, the head-capsule is strong and well chitinated. It is light-orange in colour, with dark chestnut-brown streaks arranged somewhat obliquely (fig. 5). As usual, the neighbourhood of the sutures is pale. There is a darkly pigmented patch on each side behind the feeler, but no ocelli can be distinguished; apparently the sense of sight has been lost in correlation with the burrowing habit of the larva.

The feeler is excessively reduced (fig. 3), consisting only of a short and wide basal segment and a sub-conical terminal segment. No trace of sensory structures can be seen on the latter, but the basal segment bears a short curved spine externally, and a prominent blunt spine with two smaller ones posteriorly.

The labrum (fig. 10) is light-yellow in colour, with longitudinal ridges and furrows on the distal part of its dorsal surface, on which four prominent bristles are situated. Its free edge is beset with four pairs of stout and a number of slender bristles, and a collection of tooth-like projections.

The mandible (fig. 11) is strong, with three prominent apical

¹ All the references to figures in this description are to Plate XL.

teeth, and a large globular condyle for articulation with the head capsule.

The first maxilla (fig. 12) is of the shape usual in larvæ of this family, the palp being feebly chitinized and imperfectly segmented, while the galea and the lacinia are not distinct from one another. The extremity of the lacinia carries several blunt, stout spines, and along the ridge which appears to represent the inner edge of the galea there are four long flexible bristles. The outer edge of the galea is strongly chitinized.

The second pair of maxillæ are intimately fused to form the labium (fig. 13), which consists of a broadly truncated triangular basal part, strongly chitinized externally, but white and membranous centrally, and carrying the feebly chitinized palps, each with a broad basal and a slender terminal segment.

Thorax.—The pronotum is firm and coriaceous in texture, pale in colour, and of somewhat wrinkled surface, with four series of dark impressed punctures arranged lengthwise (fig. 1). On the mesothorax and the metathorax there is a conspicuous darkish granular lateral patch carrying three strong bristles, and a smaller dorso-lateral patch with one bristle. The thoracic spiracles are situated ventro-laterally between the bases of the front and intermediate legs (fig. 1).

The legs (figs. 1, 8) are short and stout, showing only three distinct segments. A small sub-triangular, strongly chitinized thoracic sclerite overhangs the base of each leg, and the proximal segment of the leg is strengthened by a broad, arched, chitinized region, beset with a series of strong bristles. There is a similar but narrow sclerite at the base of the second segment. The terminal segment carries a strong claw, from the base of which projects a long setiform process, while internally to the claw is situated a large, wrinkled bladder-like tunica (fig. 9). It is impossible not to be struck with the similarity of this arrangement to what is found in the foot of a Collembolan of the genus *Sminthurus*.

Abdomen.—The first eight abdominal segments are all closely alike (figs. 1, 6, 7). The circular spiracle is situated laterally; ventral to it is a dark, granular patch with two bristles on either side, a smaller, similar patch with one bristle, and dorso-anteriorly to it another small patch with one bristle. Three transverse rows

of simple bristles—2, 2, 4—are to be seen on the dorsal region of each of these segments.

The ninth abdominal segment (figs. 1, 6) has the tergum well chitinized, with straight lateral and rounded hinder margins, the central region being somewhat depressed and marked by longitudinal series of dark, impressed punctures. It is raised into two prominent hooked spines, which point upwards and inwards.

The only record known to me of this species as a destructive insect in the British Islands is that of Ormerod (13), who, in March, 1878, found the larvæ boring in the stems and “bulbs” of turnips in her Middlesex garden. The method of feeding in these turnips was apparently much the same as in the cabbages now under discussion, the tunnels commencing about the ground-level and running thence upwards into the stem or leaf-stalks, and downwards into the “bulb.” No subsequent observation of the same kind in our own countries seems to have been made. But on the Continent these larvæ are well known through their serious ravages to the Rape crop. There, according to Ritzema Bos, who gives a full account of their habits (3, pp. 367–9), there is an early spring generation of beetles whose larvæ feed in the leaf-stalks of both winter and summer crops, from February till April, finally developing into a summer brood of beetles, which lay their eggs in autumn at the bases of the leaf-stalks of the young winter rape-plants. The larvæ hatched from these eggs bore their way into the stems and hibernate there, being able to endure the greatest cold; they finally develop into the spring brood of beetles. There is nothing in the life-history as observed by Ormerod and myself in England and Ireland respectively, inconsistent with the insect being also “double-brooded” here. Many insects, however, which have regularly two generations in the year on the Continent have usually one only in our islands.

MANGOLD INSECTS.

The Mangold Fly.

Pegomyia betæ (Curtis).

Leaves of mangolds, badly blistered by the maggots of this well-known fly, were received from Co. Cavan, in June. An

account of this insect has recently been given in this series of papers (4, pp. 289–291, Plates XXIII.–XXIV.).

The Beet Carrion Beetle.

Silpha opaca, Linn.

Specimens of the black, woodlouse-like grubs of this beetle were sent, in June, by Mr. O. W. H. Roulston, who had received them from Rathdrum, Co. Wicklow; it was stated that they had “practically eaten out a mangold crop.” The presence of this beetle as an injurious insect has been noticed rarely at rather long intervals in our islands. The earliest record—that of Curtis (7, pp. 388–393)—was from the North of Ireland, and it seems always to have been more prevalent here than in England. The occasional vegetable-ravaging habits of these insects are interesting and noteworthy, because the family Silphidæ are, as a whole, carrion feeders, certain species, however, preying on other insects, or on snails. The genus *Silpha* contains beetles that are flattened in shape, and more or less rotund in outline, the clubbed feelers having only nine segments. *S. opaca* may be distinguished from the other British and Irish species by its truncate pronotum, short head, deeply emarginate labrum (upper lip), and very distinctly clubbed feelers, the seventh antennal segment being markedly narrower than the eighth. It is a dull black beetle, 10 mm. ($\frac{2}{5}$ -inch) long, and clothed with yellowish pubescence. (See Fowler, 8, iii., pp. 47, 50.)

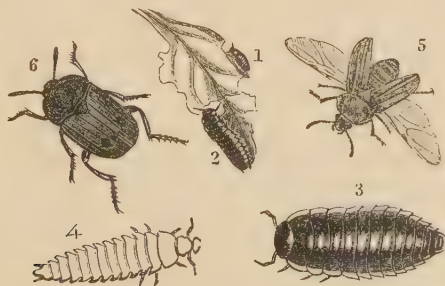


FIG. 4.—5, 6, Beet Carrion Beetle (*Silpha opaca*, Linn.) Magnified. 1, 2, larvæ on leaf, natural size. 3, 4, larvæ of *Silpha*, twice natural size. From Ormerod's "Reports," after Curtis.

The larvæ are flattened, hard-skinned insects with relatively elongate feelers on the head, a semi-circular prothorax, and the other trunk-segments with sharp, backwardly produced edges, the hindmost bearing a pair of short tail-processes (fig. 4, 3, 4). The form of the body, therefore, recalls strikingly that of a woodlouse, and these larvæ are very active. When they attack beet and mangold crops, they feed "mostly during the evening and early morning, when the leafage is moist, taking the young leaves first, and eating them down to the soil" (Ormerod, 12, 1895, p. 58). Later the grubs attack the root, gnawing it through just below the surface of the ground. When fully grown, they pupate in the soil, and after about three weeks' interval reappear as beetles. But few suggestions have been made for checking the ravages of these beetles. Ormerod (12, 1895, p. 59) recommended dusting the plants with a mixture of soot and lime while the dew is on the leaves, or entrapping the beetles and their grubs by placing putrid meat, dead birds, and similar objects about the infested fields, these carrion-traps to be, of course, subsequently collected and destroyed. The latter plan is stated by Theobald (15, i., p. 6) to prove effectual.

The Turnip Moth.

Agrotis segetum, Schiff.

Caterpillars of this common moth were received early in September from Stradbally, Queen's County. They had been feeding on mangolds in the same manner as they usually feed on turnips, and their presence led to blackening and putrefaction of the tops of the roots and the leaf-stalks. A similar attack by caterpillars of *Agrotis segetum* and the allied *A. exclamationis* on mangold has been recorded by Ormerod (12, 1893, pp. 54-60).

Agrotis segetum is one of the commonest of our Noctuidæ or Owl-moths. Moths of the genus *Agrotis* have long, narrow forewings, the thorax crested, the abdomen smooth, and the eyes not hairy. In *A. segetum* (fig. 5) the male insect has pectinated feelers, narrow, pale-brown forewings with dark orbicular and reniform markings ("stigmata"), and clear white hindwings; the female usually has uniformly blackish forewings and greyish hindwings, with dark-scaled nervures. The moth measures

38–40 mm. (about $1\frac{1}{2}$ inch) across the outspread wings (Barrett, 1, iii., p. 288). These insects are on the wing in June, and the females lay their eggs on all kinds of low herbaceous plants. The caterpillars hide in the ground by day, and come out to feed at night; their common habit—as that of other agrotid larvæ—is to gnaw through the stems of young plants close to the surface of the ground, hence their farm-name of “surface caterpillars” or “cut-worms.” Turnip and mangold “bulbs” afford food and shelter for a number of these destructive caterpillars. The great majority of the caterpillars of this moth live through the winter, feeding when the weather is mild, becoming torpid during periods of cold, and not attaining their full growth until the succeeding April; but a few individuals may feed up quickly, so as to pupate in August, and to develop into an autumn brood of moths.



FIG. 5.—Turnip Moth (*Agrotis segetum*, Schiff.) 1, male; 2, caterpillar, natural size. From Ormerod's "Reports," after Curtis.

The caterpillar, when fully grown, is 36 mm. ($1\frac{1}{2}$ inch) in length, smooth and grey, sometimes with a pinkish or purplish tint; the head is light brown with two black or dark streaks; the longitudinal lines of the body are grey and indistinct; and the spiracles are black. In the allied *A. exclamatoris* the spiracles are distinctly larger than the tubercles before and behind them. The pupa is reddish-brown, and rests beneath the surface in a small earthen chamber.

But little can be done directly for destroying these caterpillars on account of their concealed feeding habits. Turnips and mangolds badly attacked should be burned with the contained larvæ;

and it has lately been recommended by Theobald (15, i., p. 7, quoting a report of the Cornell Agricultural Experiment Station) to lay traps, consisting of bunches of clover previously poisoned by spraying with arsenical wash, about the fields, and so to compass the death of the insects. Their numbers are largely kept down by insectivorous birds.

CARROT AND POTATO INSECTS, &c.

The Carrot Fly.

Psila rosæ (Fab.).

Maggots of this fly feeding in carrots were received in July from Sligo. The insect has been fully described and figured in a recent paper of this series (4 (1904), pp. 255-7).

The Ghost Swift Moth.

Hepialus humuli (Linn.).

Complaints of damage to potato tubers by the caterpillars of this moth were received both in 1902 and in 1905 (4 (1903), pp. 195-7; (1906), p. 329). During the spring of 1906 these caterpillars were again received from potato fields near Naas, Co. Kildare.

The Spotted Millipede.

Blaniulus guttulatus (Bosc.).

Specimens of this small millipede were sent late in August from Killarney, where they had done great damage to potato crops. Reference to a similar attack by a *Blaniulus* in the year 1904 will be found in a previous paper (4, p. 295).

ORCHARD INSECTS.

The Winter Moth.

Cheimatobia brumata (Linn.).

The caterpillars of this moth were reported as injurious in apple orchards in Co. Clare and elsewhere in Ireland during the month of May. The insect has been somewhat fully described, and figured in the last of this series of papers (4, pp. 329-331, Plates

XXVII. and XXVIII.). It has been lately pointed out by the Duke of Bedford and Mr. Pickering (2) that the home-manufacture of lead arsenate—the best material for spraying in attacks by this insect—is inadvisable on account of the varying nature of commercial lead acetate and soda arsenate. Lead arsenate may now be obtained in a comparatively safe paste form (“Swift’s”) from Mr. D. M. Watson, of 61 South Great George’s street, Dublin, who has been appointed agent in Ireland by the American manufacturers.

The Lackey Moth.

Clisiocampa neustria (Linn.).

(Plate XLI.)

This insect was reported as injurious in orchards from several districts in the South of Ireland, and I received in September a twig of apple surrounded by the characteristic cylindrical egg-mass of the species from Dungarvan, Co. Waterford. The moth belongs to the “Eggar” family (*Lasiocampidæ*), which comprises robust insects mostly brown or yellow in the colour of their wings, and with the jaws so reduced that they take no food in the winged condition. The feelers are strongly pectinated, especially in the male. *Clisiocampa neustria* has wings varying in colour from pale buff to dull red-brown, the forewing being crossed by a broad central band. In the male the wingspread is about 32 mm. ($1\frac{1}{4}$ inch), in the female 38–43 mm. (over $1\frac{1}{2}$ inch). The moths fly in July and August when the eggs are laid in the twigs of various trees, being closely grouped in rings surrounding the twig, and cemented so as to form a continuous hollow cylinder. The caterpillars are not hatched until the succeeding spring; then they may be found feeding from April till June. They have the habit of spinning, by their united labour, a sheet of silk web over the branches of their food-plant. Here they live in a community until fairly well-grown, finding in the web-nest an acceptable shelter, especially in wet weather.

When fully grown, the caterpillar is 50 mm. (2 inches) long and most striking and conspicuous in appearance. The head is blue-grey, with two black spots; the first thoracic segment is also greyish, with two large, black spots. The rest of the body is

red-brown with various longitudinal stripes, black or grey, a broad, blue band along either side being especially conspicuous. A clothing of soft, yellow hairs covers the caterpillar. When it has attained its full size, the caterpillar becomes wandering in its habits, and about midsummer chooses some retired and convenient place in which to spin its firm, elongate cocoon, and pupate; cocoons may be found in a curled leaf, or on the bark of the food-tree, or in the crack of some neighbouring fence or wall. The pupal stage is short, and the moths are flying, as already mentioned, in late summer. (Barrett, 1, iii., p. 13.)

Spraying with the lead arsenate wash, as recommended for the winter moth caterpillar, is effectual also against this insect. The gregarious habit of the caterpillars, crowded together on their web, renders possible the simple remedy of cutting the shoot off, and letting it fall with the insects into a pail of paraffin and water.

Small Ermine Moths.

Hyponomeuta padellus (Linn.), and *H. malinella*, Zeller.

(Plate XLII.)

Caterpillars of these moths were sent from Co. Clare in May, with the complaint that they were proving destructive to apple-trees; while from Co. Waterford, Mr. J. Johnston, the County Agricultural Instructor, forwarded a large number of caterpillars, taken from hawthorn, stating that in parts of the county they had eaten the hedgerows almost bare of leaves.

These moths are easily recognized by their white or greyish forewings adorned with black spots, whence their name of "ermine." The species whose caterpillar commonly feeds on hawthorn is *Hyponomeuta padellus*, and it is generally considered that the apple-feeding caterpillars also belong to this moth. Theobald has lately given reasons (15, ii., pp. 31-34) for considering that the *Hyponomeuta* which eats apple foliage in these countries is identical with the Continental *H. malinella*, Zeller, and worthy of specific distinction from *H. padellus*. In *H. padellus* the head is pure white, the forewings light grey or whitish, with four longitudinal series of small black dots, only from four to six occurring in the lowest series; the fringes of the forewings are grey. The hind-

wings are dark grey with pale grey fringes, whose tips are white. Theobald states that in the apple species (*H. malinella*) the hind-wing fringes are uniformly grey. *H. padellus* has a wingspread of 22 mm. ($\frac{1}{2}$ inch or less). According to Theobald, *H. malinella* is constantly smaller—17 mm. ($\frac{3}{4}$ inch).

The moths fly in July and August. They lay their eggs in groups of fifty or more, forming circular patches on the small twigs of the food-plant, covering them with a sticky, protective secretion which hardens and darkens on exposure to the air. The caterpillars are hatched in autumn, and remain under the protective covering just mentioned through the winter; in spring they emerge and enter the opening buds. Later they mine into the leaves, feeding for a while on the soft, green central tissue. In May and June they come out and feed externally on the foliage, spinning over the twigs and leaves a mass of web, which serves as a protective nest for a large community. Thus, in all stages of their lives, the caterpillars live in some kind of shelter. Towards midsummer they become fully grown. They are then about 25 mm. (1 inch) in length, with black heads, and bodies of a greenish or yellowish grey, spotted with black. They pupate in white spindle-shaped cocoons scattered about the web nests, from which the moths emerge in a few weeks. (See Plate XLII.)

On account of the protection afforded by the webs, arsenical spraying has but little effect upon these caterpillars in summer, though the use of caustic alkali wash in winter may be partially effective against the young larvæ. The most advisable practice is to cut off and collect the nests with the feeding caterpillars in May and June, either burning them or dropping them into pails of lime.

The Plum Aphid.

Aphis pruni, Réaumur.

Leaves of plum-trees, with numerous specimens of this common aphid, were received in June from the neighbourhood of Dublin. This is one of those species of aphid which cause the leaves, beneath which they live, to curl up, so that it is difficult to bring any wash to bear upon them. The life-history of this insect has lately been described by Theobald (15, ii. pp. 148–150). Spraying

with quassia-wash, or paraffin emulsion very early in the season—the end of March, or beginning of April—when the first young aphids come out of the winter eggs, and before they multiply and begin to curl the leaves, is advisable; such spraying should be repeated two or three times at intervals of a week. Autumn spraying—late in September—so as to kill the egg-laying females when on the trees, is also advantageous.

The Mussel Scale-Insect.

Mytilaspis pomorum (Bouché).

(Plate XLIII. A.)

This common and well-known scale-insect is doubtless present in numbers every year on apple-trees. Specimens were received from

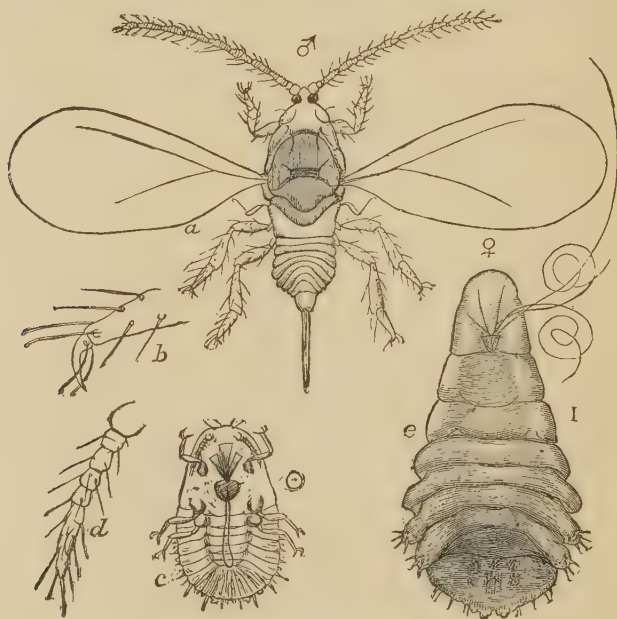


FIG. 6.—Mussel Scale-Insect (*Mytilaspis pomorum*, Bouché). (a) male, magnified 20 times; (b) foot of male, more highly magnified; (c) larva magnified 20 times; (d) feeler of larva more highly magnified; (e) female, ventral view, magnified 40 times.—From Howard, Year-book, U.S. Dept. Agr., 1894.

Co. Clare in May. In October, 1906, I received from Mr. G. O. Sherrard twigs from a peach-tree at Ballyhaise, Co. Cavan, terribly

infested with these insects (Plate XLIII. A.), the familiar elongate female scales, about 3 mm. ($\frac{1}{8}$ inch) long, being crowded together so as to cover the bark almost entirely. The legless, swollen body of the adult female may be found under the narrow end of the scale in late summer and autumn, the broad end being filled with eggs—possibly up to eighty in number (fig. 7, *a b*). The scale, which is formed partly by the waxy secretion, and partly by the excrement

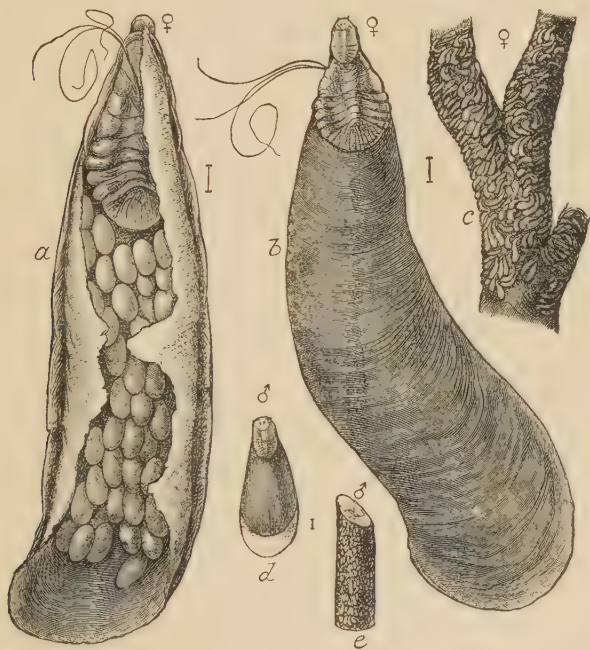


FIG. 7.—Mussel Scale-Insect (*Mytilaspis pomorum*, Bouché). (*a*) female from beneath, showing eggs protected by scale; (*b*) the same from above, magnified 24 times; (*c*) female and (*e*) male scales on twig, natural size; (*d*) male scale magnified 12 times.—From Howard, Year-book, U.S. Dept. Agr., 1894.

of the insect, serves as a protective covering for the eggs, beneath which they can safely pass the winter. From these eggs the young larvæ (fig. 6, *c*) are hatched in May. They are white, flattened in form, and possessed of six legs, so that they run actively over the branches of their native tree. It is thought that they are often carried from tree to tree by wind, by birds, or by flying

insects. A few days after hatching, the larva fixes itself, plunging its long proboscis into the bark, and commencing to secrete its protective scale. The legs disappear, and the insect becomes sluggish and motionless, though it continues to feed voraciously. If a male, the scale is complete in about six weeks, being then 1 mm. ($\frac{1}{25}$ inch long), and the insect assumes a resting "pupal" condition with distinct wing rudiments. In July the small, winged male (fig. 6, *a*) emerges from the scale and flies in search of his mate. The female is ready for fertilization in July or August, her scale being then about the same size as the male's. Afterwards it increases in size, as already mentioned. But the males are very scarce, and the females appear often to lay unfertilized eggs, affording an example of the virgin reproduction (parthenogenesis) often to be observed in this group of insects, and constantly among their allies, the Aphidæ.

For the destruction of scale-insects, paraffin emulsion should be applied in summer, and caustic alkali wash in winter. The emulsion acts directly on the insects, the paraffin being a "contact-poison." Newstead, from whose recent monograph (11) the preceding notes on the life-history of the Mussel scale are chiefly taken, recommends that half a pound of soap should be dissolved by boiling in a gallon of soft water, and that two gallons of paraffin should be added while the water is still hot, and the mixture well churned up with a syringe until it becomes white and creamy. Before use the emulsion must be diluted with nine times its bulk of hot, soft water, and again churned up with a syringe. Where practicable, the wash should be applied to the trees with a stiff brush. The ordinary caustic alkali wash used in winter is prepared by dissolving separately in water a pound of "commercial" caustic soda and a pound of crude potash ("pearl ash"). The two solutions are then mixed up together and a pound of soft soap is added, together with water, to make up ten gallons. This wash is beneficial to fruit-trees in several ways, destroying, for example, the shelters of many injurious insects; but it is doubtful whether it has much effect on the eggs of scale-insects. According to the recent work of Pickering (2), a caustic wash mixed with paraffin will undoubtedly kill the scale-insects' eggs.

Scale-Insects.*Lecanium capreæ* (Linn.).

The apple-twigs from County Cavan mentioned above, infested with the Mussel-scales, had also a few examples of the much larger scale of *Lecanium capreæ*. The same species was also present on the peach branches from Ballyhaise. According to Newstead (11, ii., pp. 105–113), the larvæ are hatched in late summer and undergo their first moult before winter, fixing themselves permanently to the branches. The males are fully developed at the end of April or early in May, and the females lay their eggs in May and June, a single individual possibly producing 2,000 offspring.

The Spotted Millipede.*Blaniulus guttulatus* (Bosc).

Strawberries bored by specimens of these slender, white, red-spotted millipedes were received from Tralee in June; they are well-known as frequently injurious to fruit in this way, and reference has already been made to the damage done by them to potato tubers (p. 434, above).

The Black-currant Mite.*Eriophyes ribis* (Westwood).

As in previous years (4 (1904), pp. 260–2; (1905), pp. 301–2), the “big buds” on black-currant bushes, caused by these mites, again attracted notice in 1906. Red-currant shoots, also infested with the mites, were received in May from Co. Waterford, but their presence on that kind of fruit seems to have no serious effect. It has been lately stated by Collinge (6, pp. 5–8) that in the English midlands the mites have been completely cleared from infested plantations by dusting the bushes with unslacked lime (1 part), and flowers of sulphur (2 parts), three times during April and May at intervals of about three weeks. Apparently this application checks the migration of the mites from the old to the new buds.

GARDEN INSECTS, &c.**The Rose Scale-Insect.***Aulacaspis rosæ* (Bouché).

Shoots of rose-trees covered with the conspicuous white scales of this species were received in November from Mr. P. J. Callan, who had obtained them at Clonakilty, Co. Cork. According to Newstead (11, i., pp. 168-173), the crimson eggs of this species are laid in August beneath the female scales, and the larvæ are already active in September. The male larvæ moult and settle down, commencing to form their scales in autumn; but the female larvæ remain unchanged through the winter, moving about actively even during frosts, though sometimes they fix themselves to the shoots. In spring their development proceeds, and the females are ready for fecundation in May, the males having then completed their transformations and acquired their wings. The scale of the female is then completed, and her orange-red body may be found beneath it in late summer.

White Springtails.*Lipura ambulans* (Linn.).

These small insects were again reported as injurious, information being received in February that they had damaged peas, beans, and other vegetables in a garden in County Dublin, eating across the young green shoots just below the ground. References to these springtails and their ravages during recent years will be found in former papers of this series (4 (1904), pp. 251-3; (1905), pp. 293-4; (1906), p. 340).

Vine Weevils.*Otiorrhynchus* sp.

Complaint was received in November by the Editor of the *Farmers' Gazette* that the grubs of a species of *Otiorrhynchus* were injuring begonia tubers in a garden in County Wexford. For the destruction of these soft white grubs—often injurious to the roots of ornamental plants—watering with carbolic acid

emulsion has been recommended by Theobald (15, ii., p. 160). A quart of soft soap is dissolved in a gallon of boiling soft water, and a pint of crude carbolic acid is added. This must be well churned up to form a creamy emulsion, and diluted with thirty times its bulk of water before use.

Enchytræid Worms.

Enchytræus albidus Henle.

From a garden at Killiney, County Dublin, soil was received in August, in which spinach was growing, containing numerous specimens of enchytræid worms. Mr. Rowland Southern has kindly identified them as belonging to the species *Enchytræus albidus*, Henle. References to damage in various parts of Ireland by similar worms may be found in my previous papers (4 (1903), pp. 202-3; (1905), pp. 297-8; (1907), 339). Theobald has recommended (15, ii., pp. 152-3) application of lime-water, prepared by mixing a pound of quicklime with a gallon of water and afterwards straining; or of corrosive sublimate, an ounce of the poison to six gallons of water.

FOREST INSECTS.

The Pine Weevil.

Hyllobius abietis (Linn.).

Specimens of this well-known beetle were received in May from near Macroom, County Cork, both through the County Agricultural Instructor, Mr. T. A. Rudd, and also through the *Farmers' Gazette*. The beetles had done serious injury to a young plantation of larch and Scotch pine, the bark being eaten round at the base of the trunk, in some cases so completely that young trees had been killed outright. A notice with illustration of this insect and a short account of its life-history have already been given in this volume (4 (1902), pp. 154-5, Pl. I. c.).

The Pine Bark-beetle.

Hylurgus piniperda (Linn.).

During the winter of 1905-6 much damage was done in County Dublin by these small beetles boring into pine-shoots.

When these insects leave their breeding-places in summer or autumn, they bore into young shoots about two inches below the terminal bud and work their way upwards (fig. 8, 4), through the pith, finding in the centre of the shoot both food and shelter. A mass of resin exudes from the entrance hole, and the shoot, greatly weakened by the presence of the beetle, may droop or die, or be blown off by a winter storm. The loss of the shoots leads naturally to the deformation of the trees, and great damage may result to plantations from the attacks of these small beetles, which are only about 5 mm. ($\frac{1}{5}$ inch) in length, cylindrical in form, and dark-brown or black in colour.

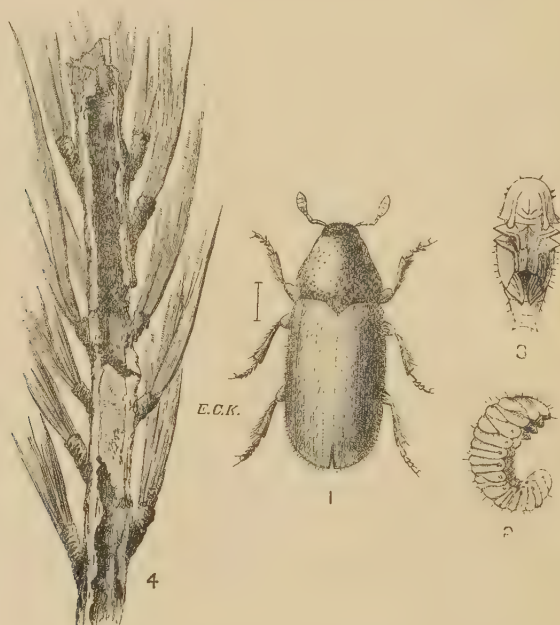


FIG. 8.—Pine Beetle (*Hylurgus piniperda*), magnified 6 times; 2, 3, larva and pupa, magnified 3 times; 4, tunnelled pine-shoot. From Omerod's "Reports."

The life-history of this beetle (fig. 8, 1) has long been well known. The insects come out from their winter shelters in April, when they make their way to pine-trunks for breeding purposes, choosing by preference trees that have been dead or felled for

some months. The flow of sap in a sound living trunk renders such trees unacceptable to the insects, but if no dead trunks be available they will attack fairly healthy trees, which may suffer severely from their ravages. The male and female beetles pair and bore through the bark, the female making a fairly straight tunnel about four inches long between the bark and the wood, but mostly hollowed out of the former (fig. 9). As she forms her tunnel the female lays eggs alternately on either side of it to the number of perhaps a hundred. From the eggs are hatched stout, fleshy larvæ (fig. 8, 2, with white wrinkled cuticle and small, brown heads.

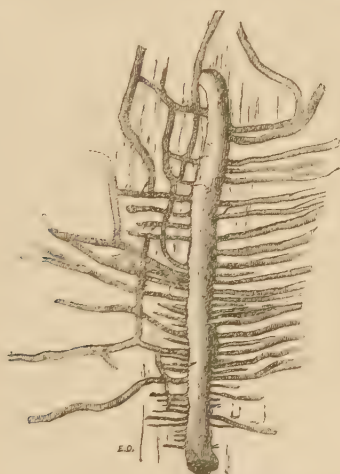


FIG. 9.—Burrows in pine-bark, made by *Hylurgus piniperda* and its larvæ. From Ormerod's "Reports."

These eat their way along tunnels of their own, which run outwards roughly at right angles from the mother's gallery (fig. 9). In about a month they become fully grown and pupate (fig. 8, 3) in ovoid chambers at the end of their tunnels. About a fortnight later the perfect beetles are developed, and they bore their way straight out from the pupating chambers through the bark, which looks, after their emergence, as if riddled with small shot.

Midsummer is the usual time when the new brood of beetles appear. These insects may proceed at once to bore into the young shoots as already described, postponing breeding till the next

spring, or they may pair immediately and seek suitable trunks for egg-laying, repeating the operations of their parents and giving rise to a second generation of beetles, which appear in August, and then bore into the shoots. It is this habit of tunnelling the shoots which makes the beetle such a pest to the forester. And an abundant supply of beetles to do damage is assured by leaving felled trunks and dying trees lying neglected in the woods. In one locality which I visited, where scores of trees had been badly injured by the shoot-boring operations of the beetles, felled trunks with the bark on, beneath which thousands of beetles had developed, were lying about in all directions. A knowledge of the life-history of this insect indicates clearly the practical measures to adopt for its destruction. Felled trees may be left lying with their bark on, through the winter until spring, to attract the beetles to breed in them. Then, about the middle of May, when hundreds of larvæ and pupæ are living and feeding beneath the bark of these trunks, the bark should be removed and burned. Such a system of "trapping" is commonly adopted with success by the Continental foresters. The stumps of felled trees also are sometimes used as breeding-places by *Hylurgus*. These may be utilized as "traps" in the same way.

The Giant Sawfly.

Sirex gigas (Linn.).

(Plate XLIII. B.)

The year 1906 was remarkable on account of the large numbers of this conspicuous sawfly (or "wood-wasp") taken in various parts of Ireland. Most of the insects were females, and were obtained during July and August. The localities ranged from Gorey, County Wexford, to Kerry, Limerick, and to various places in County Longford. In the latter county the insect seemed to attract unusual attention, and a letter appeared in one of the Dublin newspapers recording the advent in Ireland of a "South African horsefly," which turned out on inquiry to be a female *Sirex*. Complaints were also received of injury to timber by the breeding larvæ of the insect. In one case the injured wood was from a tree which had been blown down three years previously.

Damaged or diseased trees are usually selected by the female *Sirex* for egg-laying; by means of her formidable ovipositor she places the eggs deep down in the wood, and the larvæ take some years to complete their growth. Cutting and using the timber may not lead to the death of the larvæ: according to Theobald (15, i., pp. 36-7), they may pupate and develop into flies even if the wood be creosoted. Hence it is desirable to cut down and burn all attacked trees, as the flies, if numerous, may seek healthy trees for egg-laying. The insect is so conspicuous that it may perhaps seem more abundant than it really is.

The Pine Sawfly.

Lophyrus pini (Linn.).

Caterpillars of the common pine sawfly (*Lophyrus pini*) were received in September from Belfast, with the information that they had caused much damage in the neighbourhood to Scotch and Austrian pines. This insect is frequently destructive to conifers in Great Britain, but it seems rarely to attract attention in Ireland. The species of *Lophyrus* are characterized by the strongly pectinated feelers of the male insect.

The male of *Lophyrus pini* has a wing-spread of 14 mm. (about $\frac{3}{8}$ inch); it is black in colour with a red-tipped abdomen. The female is larger, measuring 20 mm. ($\frac{4}{5}$ inch) across the wings, and is yellow with darker thorax and a central longitudinal black band on the abdomen. There are usually two broods in the year, the flies first appearing in May when the female cuts slits in the pine needles with her ovipositor and lays her eggs, usually placing from six to ten in each slit, and covering them with resinous material scraped from the leaves. The caterpillars are hatched about a fortnight after the eggs have been laid. They feed in large companies on the pine-needles, also gnawing the bark of the shoots, and often doing much damage to the trees. They become fully grown at midsummer. By this time they have attained a length of 25 mm. (1 inch). They have eight pairs of abdominal pro-legs, in addition to the usual three pairs of legs on the thorax, and they are greenish in colour, with conspicuous black spots, pale-green when young, darker brownish-green when fully grown.

The midsummer larvæ form hard, oval cocoons among the leaves or in cracks of the bark, in which they pupate. These cocoons may serve as wintering shelters for the species ; but usually the flies are developed in July and August, and come out to pair and produce a second brood of caterpillars which feed on the trees during August and September ; the specimens received from Belfast

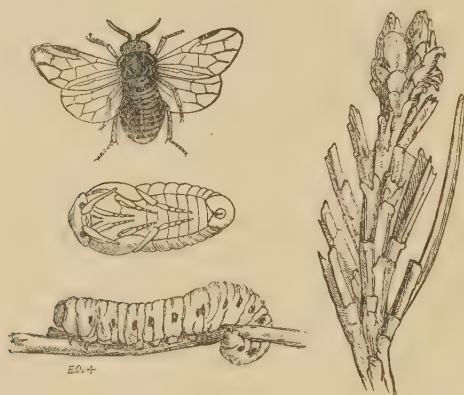


FIG. 10.—Pine Sawfly (*Lophyrus pini*), with pupa, larva, and injured shoot, slightly enlarged. From Ormerod's "Reports."

belonged, of course, to this second brood. When fully grown, these autumn caterpillars form cocoons on the ground beneath the trees among fallen needles or moss, and rest unchanged through the winter. In the succeeding spring they pupate, and quickly develop into the May brood of flies.

The conspicuous appearance of these caterpillars and their habit of feeding in companies make their destruction fairly easy. Shaking them off the trees so that they may fall on cloths, or crushing them in a mass with a gloved hand, have both been recommended. Theobald, who has given (15, ii., p. 165-9) a full account of this species and the allied *L. rufus* (Linn.), states that the larvæ migrate from a badly eaten tree to those around, and advises therefore that a ring of tar should be placed around an infested tree, and that the neighbouring trunks should also be banded. The clearance in winter of the refuse on the ground containing the hibernating cocoons is an obvious preventive measure.

OSIER INSECTS.

The Willow Beetle.

Phyllodecta vulgatissima (Linn.).

(Plate XLIV.)

At the end of May complaint was made of damage caused to osier plantations near Lurgan by small beetles. Specimens were forwarded of the leaves eaten into holes by the insects, both adult beetles of the species *Phyllodecta vulgatissima* and their larvæ being present. The genus *Phyllodecta* belongs to the same family (Chrysomelidæ) as the turnip-flies, but not to the leaping section (Halticinæ) of that family, being included among the typical leaf beetles (Chrysomelinæ). In *P. vulgatissima* (fig. 11) there are irregular lines of punctures on the wing-cases, and the colour is metallic-green or blue. The nearly allied *P. vitellinæ* (Linn.), which is also frequently injurious to osiers and willows in the

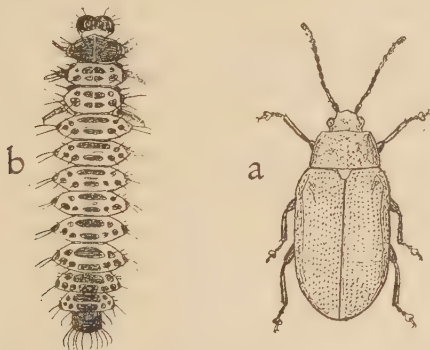


FIG. 11.—(a), Willow Beetle (*Phyllodecta vulgatissima*), and (b), its larva. Magnified 5 times.

same way, is metallic-bronze, and has the puncturation regular, (See Fowler, 8, iv., p. 317). The larvæ (fig. 11 b) have a tough yellowish cuticle, with conspicuous brown bristle-bearing tubercles on each body-segment, the head and pro-thorax being hard and black. They are consequently well adapted for their exposed feeding habits on the leaves of osiers, willows, and poplars.

As with many of the Coleoptera (beetles), these insects pass the winter in the adult state. According to Theobald (15, ii., pp. 163-5),

they shelter at that season under stones and willow-bark, in the rubbish, leaves, &c., collected in old stumps, among fallen leaves on the ground, among heaps of osier-peel, or in the thatch of peelings used for huts in osier-beds, or between the overlapping boards of sheds or huts. Such shelters should therefore be, as far as possible, abolished. It is a good plan to lay in the autumn "traps" for the beetles, such as pieces of birch-bark or osier-peelings, gathered in heaps, which may be afterwards gathered and burnt with the beetles which have collected in them. If undisturbed, the beetles come out of their winter shelters in spring, and lay their eggs beneath the leaves. In a few days the larvæ are hatched; they begin to feed beneath the leaves, subsequently eating holes through to the upper surface. When fully grown, they fall to the ground and pupate in the soil, developing in autumn into beetles, which feed for a while on the leaves, and then hibernate, as already mentioned. When the beetles and their larvæ are actually feeding in spring and summer, they may be shaken off the shoots, and caught on tarred sacks or boards. Spraying with arsenical wash—Paris green or lead arsenate—may be also confidently recommended. As the beetles may winter in flood-rubbish, it is advisable to burn this before spring.

The Osier Gall-Midge.

Rhabdophaga heterobia (Loew.).

In a previous paper of this series (4 (1905), pp. 302-4, Pl. xxvi. B) will be found an account of this midge, with reference to the damage done by its larvæ to osier plantations in County Kilkenny. During the summer of 1906, I received, through Mr. Armstrong, Superintendent of the Richmond Institution for the Blind in Dublin, galled osier shoots from Ardee, County Louth, and Mr. Armstrong informed me that the insect had done great damage to plantations in that locality, as well as in County Meath. Since my last notice of this insect, some notes on its life-history have been published by MacDougall (10), who succeeded in rearing, from galled buds, specimens of the perfect midges which emerged in July. Mr. Armstrong was so good as to send me galled shoots at intervals through the winter of 1906, and I noticed that by February,

the number of larvæ in each gall showed a reduction, only three or four being present, instead of the eight or nine to be found in summer. Careful search through a quantity of soil from beneath the osiers, kindly procured and sent by Mr. Armstrong, failed to discover any buried larvæ. I carried out this examination, thinking it possible that there might be a winter brood of buried pupæ. No support of this view was forthcoming, but the disappearance of larvæ from the galls in February suggests that there may be a very early spring brood of midges, the species having two life-cycles in the year.

HOUSE INSECTS.

The Mottled Willow Moth.

Caradrina quadripunctata, Borkh.

In the last of this series of papers (4 (1906), p. 343), reference was made to the invasion of a dwelling-house at Kilbeggan, County Westmeath, by hundreds of caterpillars of this moth. It is of interest to find from Theobald's recent report (16, pp. 103-4), that a similar occurrence was noted at Portora, Enniskillen, where these caterpillars, which "were swarming in a hay-loft, found their way in large numbers into an adjacent bedroom, in spite of all measures taken to exclude them." The occurrence of multitudes of these caterpillars in a warehouse at Douglas, Isle of Man, was noticed in 1898 by Mr. H. Shortidge Clarke (17).

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EXPLANATION OF PLATE XXXIX.

PLATE XXXIX.

- A. Cabbage Beetle (*Psylliodes chrysocephala*). Magnified 5 times.
- B. (i) Cabbage plant injured by larva of *Psylliodes chrysocephala*, showing hole through which newly-hatched larva enters the plant. (ii) Cabbage plant split open to show central cavity and decaying tissue due to the presence of the *Psylliodes* larva. From Carpenter, *Journ. Econ. Biol.*, vol. i. Photographed by T. Price.



A



i.

ii.

B

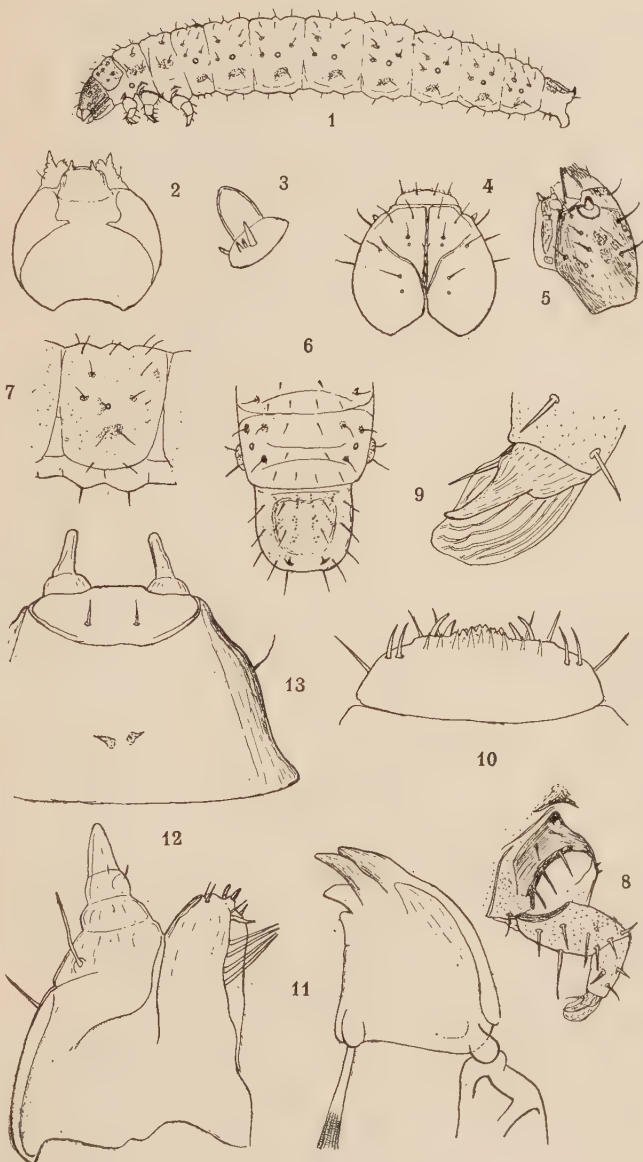
EXPLANATION OF PLATE XL.

PLATE XL.

Fig.

- 1.—Larva of *Psylliodes chrysocephala*. Lateral view. $\times 8$.
2. " " " Head, ventral view. $\times 32$.
3. " " " Right feeler, ventral view.
 $\times 240$.
4. " " " Head, dorsal view. $\times 32$.
5. " " " Head, lateral view. $\times 32$.
6. " " " Hinder abdominal segments,
dorsal view. $\times 16$.
7. " " " Fourth abdominal segment,
lateral view. $\times 16$.
8. " " " Left hind leg. $\times 48$.
9. " " " Hind foot, showing claw and
tunica. $\times 240$.
10. " " " Labrum, ventral view. $\times 160$.
11. " " " Left Mandible. $\times 160$.
12. " " " Right Maxilla. $\times 160$.
13. " " " Labium. $\times 160$.

After Carpenter, *Journ. Econ. Biol.*, vol i.



EXPLANATION OF PLATE XLI.

PLATE XLI.

Stages in the life-history of the Lackey Moth (*Clisiocampa neustria*).

Photographed from an exhibit in the Dublin Museum by T. Price.



EXPLANATION OF PLATE XLII.

PLATE XLII.

Small Ermine Moths (*Hyponomeuta padellus*), with Caterpillars on
silken web spun over Hawthorn. To the right are Cocoons
containing pupæ. Photographed by T. Price.



EXPLANATION OF PLATE XLIII.

PLATE XLIII.

- A. Peach twig covered with scales of *Mytilaspis pomorum* and a few of *Lecanium capreae*. Photographed by T. Price.
- B. Stages in the life-history of the Giant Sawfly (*Sirex gigas*). Photographed from an exhibit in the Dublin Museum by T. Price.



A



B

EXPLANATION OF PLATE XLIV.

PLATE XLIV.

Osier Leaves eaten by Willow-beetles (*Phyllodecta vulgatissima*) and
their larvæ. Photographed by T. Price.



